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Observations of the Satellite of Neptune, from photographs taken at the Royal Observatory, Greenwich, between 1907 *December* 10 *and* 1908 *March* 19.

(*Communicated by the Astronomer Royal.*)

The following measures of position-angle and distance of Neptune's satellite were made from photographs taken with the 26-inch refractor of the Thompson equatorial. The occulting shutter was used as in previous years. The photographs were taken by Messrs. Davidson, Edney, or Melotte, and were measured in a position-micrometer in direct and reversed positions by Messrs. Davidson and Melotte. The tabular positions with which comparison is made were computed from data given in the *Connaissance des Temps*, based on Dr. Hermann Struve's elements, the eccentricity of the orbit being neglected. A discussion of these residuals gives the following differences from Dr. Hermann Struve's elements in the sense Tabular—Observed:

$$du = -0^\circ{\cdot}69, \quad dN = -0^\circ{\cdot}54, \quad dI = +0^\circ{\cdot}11, \quad da = +0''{\cdot}244$$

giving for the epoch 1908·2

$$a = 16''{\cdot}027, \quad N = 188^\circ{\cdot}38, \quad I = 116^\circ{\cdot}24$$

Neptune and Satellite.

Position-angle and Distance from photographs taken with the 26-inch Refractor.

Date and G.M.T.					Position-angle.			Distance.		
					Obs.	Tab.	T—O.	Obs.	Tab.	T—O.
1907.	d	h	m	s	°	°	°	″	″	″
Dec.	10	13	47	48	241·68	243·09	+1·41	13·82	14·00	+0·18
	14	12	49	34	341·21	339·80	−1·41	12·04	11·93	−0·11
	14	13	15	59	338·86	338·36	−0·50	11·88	12·02	+0·14
1908.										
Jan.	3	11	35	18(*a*)	217·90	215·22	(−2·68)	11·16	11·86	(+0·70)
	4	11	13	40(*b*)	132·17	134·64	+2·47	13·35	13·97	+0·62
	4	11	39	10	133·26	133·58	+0·32	13·75	14·09	+0·34
	9	11	58	11	202·98	203·38	+0·40	10·87	11·37	+0·50
	11	11	27	45	82·99	83·75	+0·76	16·36	16·28	−0·08
	11	11	53	29	82·24	82·99	+0·75	16·30	16·22	−0·08
	27	9	49	5	179·03	178·08	−0·95	10·70	11·20	+0·50
	27	10	13	39	175·19	176·50	+1·31	11·34	11·23	−0·11
Feb.	3	9	15	21(*c*)	108·18	108·29	+0·11	16·25	16·42	+0·17
	6	10	2	5(*d*)	285·08	284·32	−0·76	16·23	16·62	+0·39
	6	10	35	58(*c*)	282·40	283·37	+0·97	16·29	16·67	+0·38
	10	10	0	38(*e*)	53·51	54·88	+1·37	13·08	13·35	+0·27

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Position-angle and Distance—continued.

Date and G.M.T.					Position-angle.			Distance.		
1908.	d	h	m	s	Obs.	Tab.	T—O.	Obs.	Tab.	T—O.
					°	°	°	″	″	″
Feb.	10	10	23	22	52·81	53·86	+1·05	13·33	13·25	−0·08
	10	10	43	6	51·44	53·00	+1·56	13·16	13·17	+0·01
	18	9	18	23	275·88	275·48	−0·40	16·50	16·72	+0·22
	18	9	41	43	274·99	274·83	−0·16	16·66	16·72	+0·06
	18	10	5	24	272·87	274·15	+1·28	16·31	16·71	+0·40
Mar.	5	8	1	6	23·12	23·92	+0·80	11·20	11·24	+0·04
	5	8	33	32(*f*)	19·93	21·95	+2·02	11·11	11·18	+0·07
	14	9	9	29(*b*)	180·41	182·81	+2·40	10·55	10·91	+0·36
	14	9	49	10	177·86	180·31	+2·45	10·61	10·93	+0·32
	19	10	39	41	243·84	245·23	+1·39	13·97	14·21	+0·24
	19	11	4	17	243·49	244·28	+0·79	14·06	14·11	+0·05

(*a*) Very poor photograph.
(*b*) Very diffused.
(*c*) Very faint.
(*d*) Poor photograph, satellite faint.
(*e*) Satellite diffused.
(*f*) Satellite faint.

The satellite of Neptune has now been regularly observed at Greenwich during seven successive oppositions. The differences from Dr. Hermann Struve's elements found from the observations are as follows:—

Epoch.	No. of plates.	*du*.	*d*N.	*d*I.	*da*.	2 *e*. sin Q.	2 *e*. cos Q.
		°	°	°	″		
1902·1	51	−0·95	−0·42	−0·12	+0·087	+·0005	−·0004
1903·1	63	−0·67	−0·40	−0·30	+0·092	+·0005	+·0016
1904·1	51	−0·83	−0·72	−0·20	+0·033	−·0017	+·0002
1905·1	57	−0·82	−0·95	−0·37	+0·069	+·0038	+·0053
1906·1	59	−0·90	−1·17	+0·12	+0·085	−·0043	−·0027
1907·2	29	−1·02	−0·93	−0·20	−0·008	+·0024	+·0009
1908·2	25	−0·64	−0·44	+0·11	+0·244	−·0110	+·0032

The very small eccentricity has been treated as a quantity to be determined in these solutions; accordingly the figures for *du*, *d*N, *d*I, and *da* differ slightly from those published previously in the *Monthly Notices*, in which the eccentricity is taken as 0.

Royal Observatory, Greenwich:
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On the Mathematical Theory of Two Star-drifts, and on the Systematic Motions of Zodiacal Stars.

By A. S. Eddington, B.A., M.Sc.

In a former paper,* the distribution of the proper motions of the stars was discussed from the point of view of the hypothesis of two drifts of stars. The method of analysis consisted in finding by trial and error the constants of two drifts which would lead to a distribution of proper motions (as regards direction) agreeing as nearly as possible with the observed distribution. There are evident disadvantages in a method of this kind; the difficulty of simultaneously adjusting five disposable constants, so as to obtain the best agreement with observation, is considerable; there is room for bias in deciding what is the best agreement with observation; and the method is inapplicable to the discussion of a series of proper motions of stars sparsely distributed over a large region of the sky, such as the Bradley proper motions.

It is the object of the first part of this paper (*Mathematical Theory*) to obtain from the observational data direct equations to determine the constants of the drifts. In the second part the theory is applied to the analysis of the proper motions of the Catalogue of Zodiacal Stars (*Astronomical Papers of the American Ephemeris*, vol. viii., part iii.); this is an example of a series of proper motions which, while sufficiently numerous to afford a good determination of the velocities of the drifts, are much too sparsely distributed to be analysed by the method of trial and error.

Mathematical Theory.

I have defined a "drift" to be a system of stars in which the motions of the individual stars relative to the mean of the system are haphazard; the whole system has in general a drift-motion relative to the Sun. For the sake of precision, the distribution of the haphazard or "peculiar motions" in the ideal drift is taken to be according to Maxwell's law.

In "Systematic Motions," p. 36, the law of distribution of the proper motions in the different directions was discussed for a system of stars forming a drift thus defined; the analysis may be briefly recapitulated here.

A small region of the sky is considered, and motions in the line of sight are neglected, so that the problem is two-dimensional.

Let the number of stars having component peculiar (linear) velocities between the limits (u, v) and $(u+du, v+dv)$ be

$$\frac{n_1 h^2}{\pi} e^{-h^2(u^2+v^2)} du dv \quad . \quad . \quad . \quad . \quad (1)$$

in accordance with Maxwell's law.

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* "The Systematic Motions of the Stars," *Monthly Notices*, vol. lxvii. p. 34.